

Massachusetts Institute of Technology  
Department of Physics

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## Condensed Matter Theory Seminar

"Propagation of an impurity through a quantum medium"

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**Abstract:** I will report on recent theoretical and experimental progress in understanding the dynamics of an impurity particle injected into a one-dimensional quantum liquid. I will show that the momentum distribution of the impurity subject to a constant external force exhibits characteristic Bragg reflections at the edge of an emergent Brillouin zone. As a consequence, the impurity exhibits periodic dynamics that is interpreted as Bloch oscillations, which arise even though the quantum liquid is translationally invariant. I will also discuss a quantum flutter phenomenon, whose essence is that the impurity injected into a liquid with some initial momentum sheds only a part of it to the background gas, and forms a correlated state that no longer decays in time; furthermore, if the initial momentum is large enough, the impurity undergoes long-lived oscillations. The value of the impurity's velocity at infinite time lies between zero and the speed of sound in the gas, and is determined by the injection protocol. This way, the impurity's frictionless motion is a dynamically emergent phenomenon whose description goes beyond accounting for the kinematic constraints of Landau's approach to superfluidity.

**12:00pm noon**  
**Thursday, December 21, 2017**  
**Duboc Room (4-331)**

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Host: Max Metlitski